be about 10^{14} and with such an instrument it is possible to set up photometric standards of the highest precision.

As far as straight genuine photometry is concerned, as distinguished from such related fields as colorimetry and polarimetry, it seems unlikely that the accuracy or efficiency of existing methods can be greatly improved. There is a possibility that significant improvement can be made in the existing techniques for employing infrared sensitive diode photocells but with the infrared multiplier possibly just around the corner, there may be little justification for further development.

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Baum, William A. Photometry of faint objects.

The faintness attainable in photoelectric photometry with a large telescope is usually limited more by seeing than by instrument performance, because the size of the smallest diaphragm which can safely be used to enclose a stellar image is determined by the spread of the image, provided the optics and drive of the telescope are good. The statistical fluctuation of the night sky radiation admitted by this diaphragm is the principal source of observational error. Records of the seeing experienced during photoelectric runs at Palomar in 1951 and 1952 indicate that the most frequent apparent image size, including overall turbulent excursions, is 2″ to 3″, and that nights when the images cover less than 1″ are relatively rare.

A satisfactory empirical rule-of-thumb for the 200-inch telescope is that the diaphragm size should be roughly 2″ larger than twice the apparent image size, judged visually with 10th-magnitude stars. For average seeing, a 7″ diaphragm is required, and a sky background of about 18th magnitude must be tolerated. When 1″ images occur, the diaphragm can be closed down to 4″, thereby reducing the sky background to fainter than 19th magnitude. Since the best seeing is reserved for the faintest objects, photoelectric observations of stars from 18th magnitude down to the plate limit must usually be made against sky backgrounds which contribute more light than the objects being measured.

The photoelectric photometer used during 1951 and 1952 at the prime focus of the 200-inch telescope was a conventional d.c. system employing an E.M.I. 5060 end-on type photomultiplier, a d.c. feedback amplifier, and a Brown recorder. Traces on stars brighter than 18th or 19th magnitude yielded acceptable measures, but traces on fainter stars involved deflections, star-plus-sky minus sky, which were not sufficiently greater than the random fluctuations in the trace to afford satisfactory accuracy. Larger RC time-constants and longer exposures did not provide a practical solution, partly because of variations in the night sky glow and partly because of the awkwardness of extracting results from such traces. Since this difficulty was a purely practical one arising from the form of registration rather than from any fundamental limitation of the photoelectric method, it could be overcome by adopting a charge-integrating system such as a photon counter (see following paper) in place of a rate-of-charge system such as the d.c. amplifier and recorder.

From purely statistical considerations, one can specify how many photons need to be counted in order to attain a prescribed accuracy for any given star magnitude and background level; this in turn determines the length of time which a photon-counting observation will consume. Let n represent the number of photon-counts per second from the star alone, let N be the number of photon-counts per second from the background, i.e., sky plus dark emission, and let ϵ be the probable error of n expressed in magnitudes. It can be shown that the number of seconds required for a series of alternate star and background counts, spending half the time on each, in one color is

$$t \approx \frac{2N + n}{\epsilon^2 n^2}$$

plus any additional time spent shuttling between star and background. If suitable allowances are also made for set-up time, for calibration and extinction measurements, and for a series of counts in at least one other color, the time given by the formula must be multiplied by 3 or more when estimating realistically the total time which the observation of a faint star will consume. It turns out, for example, that in order to attain an accuracy of 0.05 mag. in the photometry of a 23rd magnitude object through a 4″ diaphragm, it would be necessary to devote two full nights of good seeing, one for each color, to a single observation with the 200-inch telescope.

By an extension of the foregoing analysis, it is possible to determine objectively what magnitude ranges should be attempted during various qualities of seeing in order to obtain the maximum long-term results from the telescope.

Summarizing: seeing determines how small a diaphragm can be used, the diaphragm deter-